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RECORDS OF EYE-FREQUENTING LEPIDOPTERA FROM MAN

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Abstract: Eye-frequenting noctuids have been known from Africa since 1915 and from Southeast Asia since 1958. Their hosts are wild and domesticated members of the mammalian orders Artiodactyla, Perissodactyla and Proboscidea and include cattle, water buffalo, sheep, sambar, antelope, pigs, horses, mules, and elephants.

Previous work in northern Thailand has shown that the Noctuidae, Pyralidae and Geometridae include species that quite regularly feed on lachrymal secretions, pus and blood of some of the above-mentioned mammals.

Recent observations made in Thailand have revealed that they also frequent the eyes of human beings where they often feed on lachrymal secretions, other ocular discharges and possibly blood.

The findings recorded in this paper are based on observations made in northern Thailand under outdoor and indoor experimental conditions. Of the 20 known species of eye-frequenting moths which regularly trouble mammals in Thailand, 6 were recorded on human beings. The photographs are the first taken which show these moths on man. In addition, records from Ceylon, southern India and Burma are included, together with some of the more striking cases observed of eye-frequenting moths troubling human beings.

The Lepidoptera concerned have long been suspected of being the vectors of bovine diseases; in view of these new findings it is evident that these moths will have to be considered as potential vectors of the trachoma virus and of other causal agents of eye diseases, for example keratoconjunctivitis, ophthalmia, "pink-eye," in human beings.

Eye-frequenting noctuids have been recorded so far from a number of mammals in Africa and Southeast Asia. The first observations were made simultaneously by Marshall et al. (1915) in Nyassaland and South Africa, and by Poulton (1915 *in* Reid 1954) in Tanganyika.

Further records were summarized by Reid (1954) for Africa and by Büttiker for Cambodia (1959a, 1962a, 1962b), Thailand (1964a, 1965), India (1967); and for Rhodesia by Büttiker & Whellan (1966). On the basis of the available data it is evident that noctuids belonging to the Westermanniinae exhibit a very strong preference for lachrymal secretions of a number of bovine species and Cervidae. In a few cases blood was detected in the stomach of *Lobocraspis griseifusa* Hpsn. and *Arcyophora sylvatica* Bütt. (Büttiker 1959b, 1962b); however, the details of this peculiar blood-feeding habit have so far remained unknown and no information on the mode of uptake has been published.

More recently, certain pyralids and geometrids have also been found to make nocturnal visits to the eyes of a fairly wide range of mammals of the orders of Artiodactyla, Perissodactyla and Proboscidea (Büttiker 1964a, 1965, 1967a, b). In the meantime more observations have been made by the authors in regard to mammalian hosts, and the results are now being prepared for publication.

Following the publication of preliminary data on the eye-frequenting behavior of a number of Lepidoptera on man in Southeast Asia (Büttiker 1964b, Bänziger 1966), a special study regarding the detrimental influence of these moths was made during field work[3] conducted by the authors from 1965 to 1967 in Thailand and Malaya, and 1966 in Ceylon and southern India.

The inflammatory reaction, called *Ophthalmia nodosa*, caused in the eyes of humans by the hairs of certain insects has been described by Watson & Sevel (1965).

This paper records the observations made of noctuids, pyralids and geometrids attacking human beings, these being the first confirmed observations of their kind.

RESULTS

During nocturnal field studies of the biology, behavior, etc., of eye-frequenting Lepidoptera infesting mammals, it often happens that such moths fly about near the face of the human observer and try to alight at his eyes.

The following instances of Lepidoptera frequenting human eyes comprise only a few of the more noteworthy ones recorded in Thailand, Burma, Ceylon and southern India.

1. *Outdoor observations*

Case 1. Muag Lek (central Thailand), 16 August 1965 at 23:00, coll. H. B. While I was collecting specimens of 3 different eye-frequenting species (*Lobocraspis griseifusa* Hpsn., *Filodes fulvidorsalis* Hbn., *Pionea aureolalis* Wlk.) in a herd of cattle, the latter pyralid made continuous attempts for several minutes to alight on my face. Finally it alighted on my left cheek near the nose and started

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immediately to climb to the lower eyelid where it imbibed the lachrymal secretion for about 15 sec. The proboscis of the moth could be felt probing over the eye surface. The eye produced a considerable flow of lachrymation, and the irritation caused by the moth was uncomfortable, although not at all painful.

The moth remained feeding for 15 sec. after which it was collected for identification and fixation prior to dissection.

Case 2. Chiengmai Zoological Gardens (northern Thailand), 12 October 1965 at 23:00, coll. H. B. I was collecting eye-frequenting moths within the cage of a sambar (*Cervus unicolor*) when a specimen of *Filodes fulvidorsalis* settled on my lips and started to insert its proboscis into my nose. After a few seconds it climbed to my left eye and started to imbibe the lachrymation. The action of the moth's proboscis caused a considerably increased flow of tears. The attack brought about appreciable intermittent pain at the eyelid, at intervals of 1 to 2 sec. The painful effects could be described as resembling the pricks of minute pins on the surface of the eye (not the lid), although the proboscis was felt on the eyelids too.

After having sucked lachrymal fluid for approximately 3 min., the moth suddenly flew off and disappeared. Slight pains were felt at the lower eyelid on the following morning but the irritation disappeared in the course of that same day.

Case 3. Baan Maag near Saraburi (central Thailand), 3 March 1966 at midnight, coll. H. B. During my stay of 2 months near Saraburi, I had the assistance of 3 young Thai boys in collecting eye-frequenting Lepidoptera. During that period we were molested quite regularly by *Filodes fulvidorsalis*, specimens of which attempted to settle on the face of each of us. Single specimens tried sometimes for as long as 5 min. to feed at a suitable vantage point. However, these moths never remained at the eyes for appreciable periods. They flew off after a few seconds to seek another host. The second and more scarce species present in that area, *Hypochrosis pyrrhularia* Guen., a geometrid, was seen to fly onto the lips of 1 of the Thai boys. The insect climbed immediately to the boy's nose, remained there for a second, then flew directly to my nose. It then moved up to my right eye where it remained for about 10 to 15 sec., imbibing lachrymal secretion throughout the entire period. I felt pains similar to those described in connection with the attack of *F. fulvidorsalis* (Case 2) at the Chiengmai Zoological Gardens.

Case 4. Anuradhapura (northern Ceylon), Government Cattle Farm, coll. W. B. Several visits to the farm were paid at night when we witnessed regularly *Pionea damastesalis* as an abundant eye-frequenter on cattle. Up to 8 specimens were noted on a single eye. One of the herdsmen assisting in collecting the moths was molested by 2 specimens of *P. damastesalis* on 26 March 1966 between 20:20 and 22:15. These 2 specimens were allowed to settle for a few seconds on the eyelid where they immediately started to extend their proboscides, palpate the eye surface, and take up some lachrymation. The irritation caused him to disturb the moths which then flew off and settled on the eyes of the cattle nearby.

2. *Observations made on moths indoors*

Case 5. Chiengmai (northern Thailand), 30 May 1966 at 11:00, coll. H. B. I kept in my room of the bungalow an insect cage containing 5 specimens of *L. griseifusa*, *P. damastesalis* and *H. flavifusata*. When the cage was opened 1 of the specimens of *L. griseifusa* escaped and flew without hesitation directly to my right eyebrow. I immediately felt the oscillating movements of the proboscis. This irritation was such that I had to close the eye from time to time. However, the insect was not disturbed at all, and for at least 5 min. continued to imbibe the lachrymal secretion, which was unusually profuse. The feeding of the moth caused a continuous irritation which could be described as a stinging pain like that produced by very fine pins accompanied by characteristic intermittent burning. The latter irritation was, however, always too short lived for a clear distinction between the stinging and the burning pains.

Case 6. Maejo near Chiengmai (northern Thailand), 3 October 1966 about 06:00, coll. H. B. In this experiment in my bungalow I kept 1 specimen of *L. griseifusa* and 2 of *A. sylvatica* in my mosquito net for about 50 hr without offering them any food. After having slept the entire night undisturbed by the moths, I was attacked in the early morning by *L. griseifusa*. I suddenly tried to drive the moth away, but it returned instantly and endeavored to attach itself near my nose, lips or ears. After a few minutes of unsuccessful probing it located my left eye and immediately started to feed, remaining quietly below the eyelid.

I felt the usual irritating stings of short duration and closed my eyes in order to find out whether this would cause the moth to withdraw its proboscis. However, the insect continued to suck from the eyelid from whence I felt extremely sharp pain which could be compared with gradually penetrating stings. Whenever I opened my eyes the pains

were felt on the surface of the eye; when I closed them again the moth resumed feeding on the lid. The pains were relatively slight at the beginning of each resumption of feeding on the lid, but they commenced immediately and increased in strength considerably as feeding continued. The lachrymal secretion was very much stimulated by the activity of the moth. After 30 min. my eye was so irritated that I was forced to interrupt the experiment. A red discoloration of the eye and the inner side of the eyelid was then apparent. The inflammation lasted for the entire day during which difficulty was experienced in keeping the eye open.

Additional observations made as described in Cases 5 and 6 have been repeated several times, and the photographs were taken under the circumstances described from Thailand.

On several occasions the specimens interrupted their feeding, flew off and returned to the same eye. If the moths became quiescent they could be reanimated by breathing upon them or by touching them with a moistened finger.

When observing attacks on man and attacks on animals we could not distinguish differences in the moth's behavior. There was, however, a very pronounced irregularity in the frequency of the attacks on man. It sometimes happened that under both outdoor and indoor conditions we were not visited by a moth for many weeks; during other periods several attacks occurred in the course of only 1 or 2 nights. It was remarkable too that certain persons were visited relatively often, while others never were.

When simultaneous observations were made by 2 persons within the same mosquito net the moths sometimes changed their vantage points from 1 to the other. The pyralids and geometrids in general alight on the face of the human host after some circling, making their way to the eyes indirectly via the nose, lips, or even ears. They may pause and probe at any wet or dry secretions which have run down the face, but usually they crawl up as far as the eye and remain there.

The noctuid *L. griseifusa*, however, flies directly to the human eye. After quivering for a few seconds it then extrudes its proboscis to a length of more than 1 cm. The morphological structures of the proboscis of the noctuids have been investigated in some detail, and it seems to be evident that the rough structure enables the moths to rasp healthy host tissues.

Some of the records from other places are compiled in tabular form (TABLE 1), and the observations made on eye-frequenting moths on human beings under field conditions are summarized in TABLE 2.

The relative frequency with which the various species attacked humans, and the types of secretions on which they fed, are shown in these tables. Attacks by *F. fulvidorsalis* were in the proportion of 1 on humans to 25 on animals. For *L. griseifusa* the figures were 1 to between 300 and 600. It has to be mentioned, however, that as the latter species is the more widespread, the number of attacks by each species on humans will be about equal.

According to the field observations made, it would appear that the eye-frequenting moths do not easily locate human eyes in the dark. Unlike those of the domesticated and wild mammals, they approached the eyes of man in an indirect manner. As a rule they circled around the head for a relatively long period and then landed on the nose, lips and ears. The moths reached the eyes by crawling

TABLE 1. Additional records of eye-frequenting moths from humans.

COUNTRY	LOCALITY	SPECIES INVOLVED	DATE	OBSERVATIONS
Burma	Mandalay	*L. griseifusa* (?)	28.III.63	Sometimes the moths attack human beings at night especially when the villagers and wood cutters collect firewood and sleep in the jungle.
Thailand	Mae Joak nr Chiengmai	*P. damastesalis*	28.VI.63	One of the eyes of our field assistant was frequented by a specimen for a few seconds and was driven away.
	Chiengmai (Stud Farm)	*P. damastesalis*	2.VII.63	Several ♂♂ of *P. damastesalis* settled on the face of the car driver at intervals but were driven away before they had a chance to attach themselves on the eyes. Repeated attacks between 20.50 and 21.30 hr.
	Chiengmai	*L. griseifusa*	22.VII.63	1 ♂ settling on face of night watchman of the Zoological Gardens. After it settled firmly it was caught and kept as a record in the collection.
Ceylon	Polonnaruwa (Pelwehera)	*P. damastesalis*	23.III.66	One of the herdsmen was attacked by a specimen for a short period. However, the herdsman drove off the moth. After several unsuccessful attempts the specimen disappeared.
S. India (Madras State)	Masinagudi (Nilgiris)	*Arcyophora icterica*	8.IV.66	One specimen settled on the eye of a field assistant and started to inbibe lachrymal secretion. It was driven away, but this and another moth very eagerly tried to alight near the eye lids.

TABLE 2. Lepidoptera attacking human eyes under open-air conditions (status of investigation as per 1967).

Lepidopterous Species	Records of moths frequenting humans in Asia: Country	Author	Reference
NOCTUIDAE			
Lobocraspis griseifusa	Thailand	Bänziger	1966
		Büttiker	1964b, this report
	Burma	Büttiker	1964
Arcyophora sylvatica	Thailand	Bänziger	unpublished data
Arcyophora icterica	S. India	Büttiker	this report
NOTODONTIDAE			
Tarsolepis sommeri	Malaya	Bänziger	(unpublished data)
PYRALIDAE			
Filodes fulvidorsalis	Thailand	Bänziger	1966
Pionea damastesalis	Thailand	Bänziger	1966
		Büttiker	1964b
	Ceylon	Büttiker	this report
	S. India	Büttiker	this report
Pionea aureolalis	Thailand	Bänziger	this report
GEOMETRIDAE			
Hypochrosis hyadaria	Thailand	Bänziger	1966
Hypochrosis flavifusata	Thailand	Bänziger	1966
Hypochrosis pyrrhularia	Thailand	Bänziger	1966

up to them. On animals the behavior of geometrids and pyralids was similar. A direct flight to the eyes was generally observed with *L. griseifusa* and *A. sylvatica.*

The pains were apparent when eyes were kept open. They were produced by the species of all 3 families and could be compared with short probes with fine needles on the eye.

On closed eyes, however, *L. griseifusa* caused very strong pains on the lids, which caused long lasting irritation of the eyes. It is of interest to note that *H. flavifusata,* 1 of the geometrids, did not produce any pains when sucking at the closed eye, neither on the eye nor on the lids, as this moth took up lachrymation available only in the vicinity of the closed eye. On the basis of the observed cases of eye-frequenting behavior on the human eye in no instance could we observe any serious disease which could have been caused by the moths. The eyes showed a slight irritation for several hours due to the visit of the geometrids and pyralids. A more severe irritation was witnessed after the activity of *L. griseifusa.*

L. griseifusa may feed on man for as long as 30 min., whereas the pyralids and geometrids remain for a much shorter period. Geometrids seldom exceed more than 3 min. feeding time either on human beings or animals. The specimens of the latter family usually take up large amounts of liquid which is led to the very expandable crop. As soon as this organ is filled the moth leaves the host.

CONCLUSIONS

On the basis of the observations described in this present paper, and of the previous publications on eye-frequenting moths, it is suspected that the various species of moths concerned may be vectors of mammalian epidemic keratoconjunctivitis caused by different pathogens. Field observations made in Asia and Africa support this hypothesis, even though preliminary laboratory experiments aimed at isolating the causative agents produced no positive results. In addition, the morphology of the mouth parts of the eye-frequenting moths suggests that the cornea and/or the internal surface of the eyelids may be mechanically damaged by the rough structure. While feeding on the eyes the noctuids vibrate and by this oscillating movement induce a lachrymal flow from the eye of the host. In the case of pyralids and geometrids the flow of lachrymation is also stimulated, though to a lesser extent. There is ample evidence too that liquified dead and purulent tissue is imbibed by several species of moths. It is an open question whether eye-frequenting moths may inflict wounds to the eyelids of human beings. This latter aspect will be the subject of a special study, particularly in view of the hazard of active transmission of pathogens into the conjunctival sac, on to the cornea, or into the living tissue of the eyelids.

The mechanical damage inflicted on the eyes of man and animals is increased by the fact that

FIG. 1. *Lobocraspis griseifusa* Hpsn. (Noctuidae) sucking lachrymal fluid from the author's eye. Note the deep penetration of the proboscis between eye and eye lid. Chiengmai (N. Thailand), 30 May 1966. (Photo Bänziger)

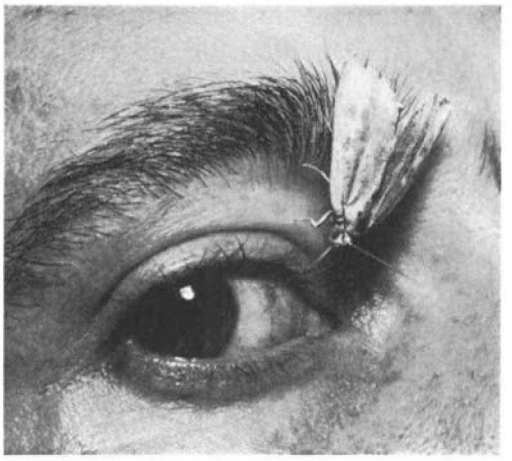

FIG. 2. *Lobocraspis griseifusa* Hpsn. (Noctuidae) feeding from lachrymal secretions of author's eye. Note the inflammation as a result of the moth's prolonged feeding. Chiengmai (N. Thailand), 30 May 1966. (Photo Bänziger)

FIG. 3. *Filodes fulvidorsalis* Hbn. (Pyralidae) feeding from the eye of a Thai assistant. Chiengmai (N. Thailand), September 1966. (Photo Bänziger)

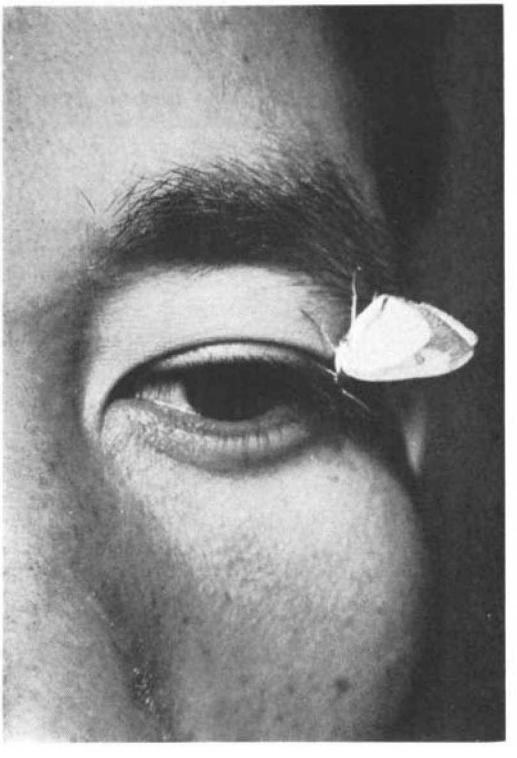

FIG. 4. *Hypochrosis hyadaria* Guen. (Geometridae) taking up lachrymal secretion. Chiengmai (N. Thailand), September 1966. (Photo Bänziger)

up to 12 moths may frequent a single eye at the same time, as was also observed on cattle and water buffaloes.

Résumé: La présence de noctuidés ophtalmotropes est signalée en Afrique depuis 1915, et dans l'Asie du Sud-Est depuis 1958. On les trouve sur des mammifères, tant sauvages que domestiques, de l'ordre des artiodactyles et périssodactyles ainsi que de celui des proboscidiens (par exemple, les bovidés, les buffles d'Asie, les ovins, les sambars, les antilopes, les porcs, les chevaux, les mules, les éléphants, et sans doute aussi sur bon nombre d'autres hôtes appartenant à ces ordres).

Il a été établi, dans plusieurs pays d'Asie, que des lépidoptères des familles des pyralidés et des géométridés, de même que les noctuidés, comprennent des espèces qui cherchent plus ou moins régulièrement leur nourriture dans les sécrétions lacrymales, dans du pus et dans le sang de quelques-uns de ces mammifères.

De récentes observations faites en Thailande, à Ceylan et en Inde méridionale ont révélé que ces insects infestent également les yeux de l'homme et se nourrissent assez fréquemment des sécrétions lacrymales ainsi que d'autres écoulements oculaires et de sang.

Les constatations décrites dans la présente communication reposent sur lesdites observations, qui ont été effectuées en plein air et dans des conditions expérimentales (sous moustiquaire). Sur les 20 espèces connues de lépidoptères ophtalmotropes qui infestent fréquemment les yeux des mammifères en Thailande, six ont été trouvées chez *l'homme*. Les photographies qui ont été prises constituent la première documentation qui existe sur le comportement spécifique de ces insectes chez l'homme.

On supçonnait depuis longtemps que des Lépidoptères pouvaient être les vecteurs de certaines maladies des bovidés: il devient maintenant manifeste, à la lumière des constatations mentionnées, qu'ils doivent être également considérées comme des vecteurs potentiels du virus du trachome et/ou d'autres agents auxquels sont imputables d'autres affections oculaires humaines (kérato-conjonctivite, ophtalmie, conjonctivite contagieuse aiguë, etc).

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